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CONFERENCE PAPER

Measuring Ocean Health in the Western Indian Ocean

The Ocean Health Index is a new method to define and quantify the health of the ocean in a comprehensive and integrated way. A healthy ocean is defined as one that can sustainability deliver a range of benefits to people now and in the future. The Ocean Health Index (the Index) tracks how countries are doing across a portfolio of 10 goals that people have for a healthy ocean. Countries can track how well they are doing for each of the 10 goals and across the goals that they have for a healthy ocean. Over time, the Index can be used to highlight areas of success or improvement. This paper summarizes some of the assumptions, methods and results of the first calculation of the index, released in the journal Nature in August 2012. At this level analysis focused on 171EEZs, belonging to 151 of the world's coastal countries.

This paper presents general information about the Index and the performance of the 10 Nairobi Convention countries (Comoros, French Indian Ocean Territories, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, Somalia, South Africa and Tanzania) to explain why such an Index is needed and what it can be used for from the perspective of the member States of the region. Future application of the Index at a regional level will provide opportunities to use a finer scale, more comprehensive data than were used at the global level, and to develop regionally-relevant weightings for the 10 goals. Additionally modeling approaches that were made in the global analysis can be improved for regional level comparisons.

The paper and discussions of the results will be used to gauge interest to conduct a regionally focused application of the Ocean Health Index for the Nairobi Convention region in 2013-14. This will culminate in an assessment of the usefulness of the index for the countries of the Nairobi Convention region to assess the health of their EEZs, inform future management and policies, and to increase the provision of ocean benefits to the citizens and coastal communities of the countries sustainably.

Prepared by the Nairobi Convention Secretariat, Conservation International and CORDIO

SUMMARY
The Ocean Health Index is a new method to define and quantify the health of the ocean in a comprehensive and integrated way. A healthy ocean is defined as one that can sustainability deliver a range of benefits to people now and in the future. The Ocean Health Index (the Index) tracks how countries are doing across a portfolio of 10 goals that people have for a healthy ocean. Using scores as a common language, countries can track how well they are doing for each of the 10 goals and across their national priorities for ocean health. Over time, the Index can be used to highlight areas of success or improvement. This paper summarizes some of the assumptions, methods and results of the first calculation of the Index, released in the journal Nature in August 2012. At this level the Index is focused on 171 EEZs, belong to 151 of the world's coastal countries.
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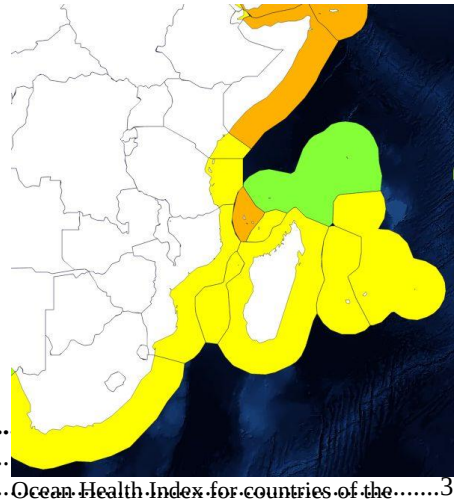


Ocean Health Index for countries of the Western Indian Ocean

Introduction To The Ocean Health Index

Humans are part of the marine ecosystem because our activitiesnow affect all parts of the ocean.The Ocean Health Indexasserts that *a healthy ocean sustainably delivers a range of benefits to people now and in the future.* Through this lens, a healthy ocean may be pristine (untouched) in areas deliberately set aside as reserves, but elsewhere it is healthy because it provides services to people and when those services are obtained with safeguards that limitdamage so that it can continue providing those benefits forever.

Fig. 1. The ten public goals (and six sub-goals) used in calculating the Ocean Health Index.

The first step for OHI was to calculate ocean health for the EEZs of all countries, averaged in a global score. These results were published in the journal Nature on 15 August 2012[1]. As a followup to this, the OHI team is investigating the health of several regional focal areas to better evaluate the Index, includinga number of Large Marine Ecosystems, including the California Current, the mid-Atlantic Bight of the US, the eastern Brazil Shelf LME and the Republic of Fiji. The Western Indian Ocean is being considered for regional focus in 2013-14, with this paper being produced to explore the interest of regional countries and stakeholders in participating in this effort.

How is the OHI calculated?

The Index identifies and evaluates 10 public goals for a healthy ocean (figure) and each goal is scored from 0 to 100. The overall score for each country is the average of its 10 goal scores.Scores were initially calculated for 171 EEZs, representing all of the world's 151 coastal countries. The global Ocean Health Index score is the average of all country scoresweighted proportionally by their Exclusive Economic Zones (EEZ[2]) areas. At present, the goal scores for a country are averaged together, though for goals that do not apply to a country, they are omitted.With improved knowledge, andfor studies at different scales and contexts, such as for a region, some goals couldbe weighted more highly than others to reflect national and regional priorities.
A number of indicators or variables may be used to calculate a goal, or even multiple goals. For example, the state of coastal habitats may be used as an input to Carbon Storage, Coastal Protection, Biodiversity and Food Production.Each goal is evaluated for itsPresent and Likely Future Status (in the next 5 years).The Likely Future Status is first calculated based on Trend, Pressures and Resilience, then is averaged with the Present Status to obtain the goal score.

Present Status
Is the goal's present value (represented by the most recent data available) compared to a goal-specific reference point.

Likely Future Status		
Trend is the average percentage change in Status shown by the most recent 5 years of data.	**Pressure** is the sum of the ecological and social pressures likely to depress near-future scores for a goal.	**Resilience** is the sum of ecological factors (if any) and social initiatives (policies, laws etc.) enacted that can reduce pressures and therefore increase near-future scores for a goal.

The Ocean Health Index uses more than 100 global databases and strives for the most current data available. However, many datasets are not fully updated to 2012, or have patchy coverage requiring modeled interpolation, or may show common values for adjacent countries. Thus the index is not perfect, and improvements will be done in subsequent years, as well as at regional levels where higher resolution data may be available. The Index is structured so it could be updatedannually to check progress, though this also depends on how frequently data layers are updated by their hosts. Details on methods and data layers are provided at www.oceanhealthindex.org/about/methods .
The status of each goalis evaluated in relation to a goal-specific "reference point", which wasdetermined in one of four ways (below). In all cases, reference points were chosen to be 'SMART'[3]:

- against a calculated optimum point (e.g. artisanal fishing catch in relation to the amount of effort made)
- against a specific reference point in time (in the past – e.g. Carbon Storage)
- against a 'best-case' country (e.g. mariculture, which uses China as the reference point)
- against a legal/agreed reference (e.g. Clean Waters, Iconic Species)

What does the score mean?

A goal score of 100 means that the evaluated system has achieved its defined target (reference point), is sustainably delivering all of the specified benefits that it can, and is likely to continue doing so in the near future. Alow goal score means that the maximum benefit is not being obtained and/or is not being obtained in a sustainable way. For example, the very low food provision scores typically indicate that wild caught fisheries are overharvesting fish and/or harvesting them in non- sustainable ways; and that mariculture is not developed to its full potential in most countries. A goal score of zero indicates that global data were available, but that the country either did not achieve any of the available benefits, or that the benefits it did obtain were gained in a manner that was not sustainable. For example, countries where fish catches exceeded the multi-species

1 Halpern et al. – main reference
[2] EEZ - waters under the jurisdiction of countries (or their territories) that extend outward to 200 nautical miles from the shore. For this calculation, High Seas, or areas outside of national jurisdiction, were not included.
[3] SMART Specific, Measurable, Ambitious, Realistic, and Time-bound

Maximum Sustainable Yield by >100% received a score of zero (0). If a goal does not apply to a country, its score is left blank and it is not used in calculating the overall score.
It may be possible to score 100for a national score, but we have yet to see this result. This is because even though all goals must be achieved sustainably, negative interactions between goals (and perhaps between countries) may occur. For example, development to increase Tourism or Mariculture could compromise coastal habitats, decreasing scores in other goals, e.g. Carbon Storage, Coastal Protection, Biodiversity or Food Production. Goals such as Food Production, Natural Products, Tourism and Recreation and Livelihoods and Economies all have the potential to increase Pressures that could decrease benefits from othergoals. On the other hand, improving scores for goals such as Clean Waters, Biodiversity, Coastal Protection, Sense of Place and Carbon Storage, could improve performance of other goals by decreasing the Pressures acting on them.
It is worth noting that a country may be satisfied to not fully use ocean benefits such as food or tourism, i.e. to keep a buffer of unutilized resource against future uncertainty; this would produce a score < 100 in the current calculation.
For further materials and downloads on the Ocean Health Index, visit the following websites:

Global - www.oceanhealthindex.org
Western Indian Ocean countries - https://sites.google.com/a/conservation.org/ocean-health-index---wio/

The Global Index

GLOBAL SCORE: 60

The global score of 60 is a long way from 100 and sends a strong message that there is considerable opportunity to enjoy more benefits if we manage ocean use in more sustainable ways.Conversely, the score is not as bad as some might expect based on public attention to environmental disasters or large-scale global trends; but it is not nearly as good as it must befor the ocean to improve human well-being to the full extent it could.

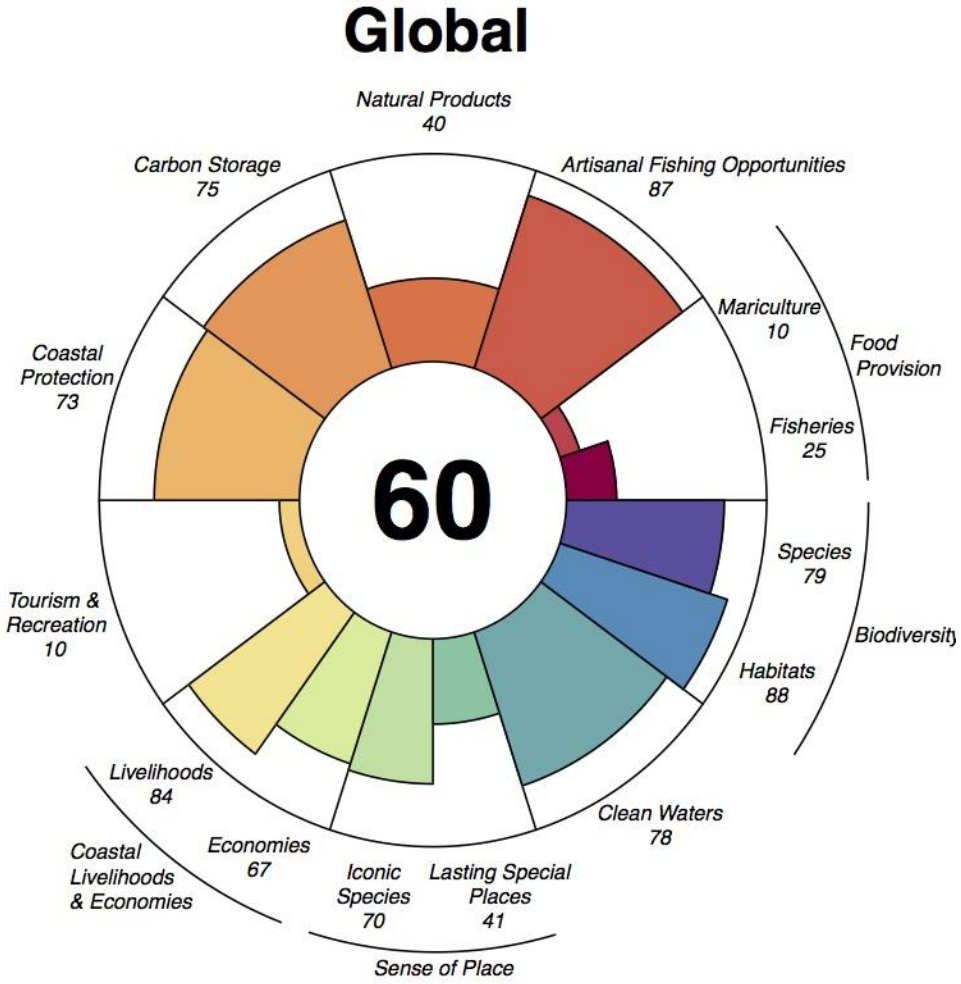


Fig. 2. The Global OHI score of 60, showing how it is comprised of higher and lower scores for individual goals and sub-goals.

COUNTRYSCORES: 36 to 86

Country scores ranged from 36 to 86 (Jarvis Island). Four of the five highest scoring countries (Jarvis Island, USA Pacific Uninhabited Territories, Clipperton Island, Republic of Seychelles and Germany) are oceanic island territories or nations. The first three are effectively uninhabited, so they are not scored for extractive or economic goals: Food Production, Artisinal Fishing Opportunities, Natural Products, Tourism & Recreation, Livelihoods & Economies; and they donot have Carbon-Storing habitats. However, they score highly on the benefits they do provide: Coastal Protection, Sense of Place, Clean Waters and Biodiversity. Even though the locations themselves are uninhabited, their designation as wildlife refuges, national marine monuments and registered historic places provide and protect Sense of Place benefits for citizens throughout the world. Seychelles has a population of approximately 85,000, good governance and a strong economic base of tourism. Germany is large, developed, industrialized and has strong governance and strong national commitment to environmental quality.

These results show that despite the Ocean Health Index's emphasis on benefits to people, pristine locations can score very high; and developed countries with successful governance and far-sighted social, economic and environmental planning can also score highly.

The eightlowest scoring countries (in descending order) were: Republic of the Congo, Senegal, Ghana, Guinea-Bissau, Democratic Republic of the Congo, Ivory Coast, Liberia and Sierra Leone. All scored 40 or below. All are located (or have their EEZs) in western Africa. All are poor and most have a recent history of war, civil strife, ethnic conflict and/or dictatorship. Their fisheries are subject to massive, often unregulated pressure from Distant Water Fishing Nations (DFWNs). Countries with those conditions do not have the resources or opportunity to address social or environmental needs; and they cannot take the social Resilience actions necessary to reduce social and environmental Pressures. Substantial increase in global Ocean Health Index scores will be limited if such countries cannot escape from conditions of governance, poverty and violence that now prevail.

The goal and sub-goal scores can provide individual countries with guidance on the highest priority areas to invest effort in to raise their ocean health scores. Because of the aspect of benefits in the score calculations, this automatically reflects increased provision of benefits socially and economically, as well as environmentally.

The launch of the Ocean Health Index in August 2012 generated at least 340 unique news stories in 26 countries with a reach of 120 million people. To date, government agencies in Brazil, China, Colombia and Ecuador have requested detailed briefings on the Ocean Health Index methodology and results and are exploring the application of the methodology at a national or subnational level.

The Ocean Health Index for Western Indian Ocean countries

REGIONAL SCORE: 56

The regional average for WIO countries, weighted by their EEZ areas, is 56, slightly below the global score of 60.

COUNTRY SCORES: 47 TO 73

Country scores in the region range from 47 to 73 (fig. 3). Seychelles, Tanzania and Mauritius equal or exceed the global score; the other 7 countries fall below it.

The scores for the countries of the WIO region are shown in various formats here, to facilitate discussion of the Index results for the region:

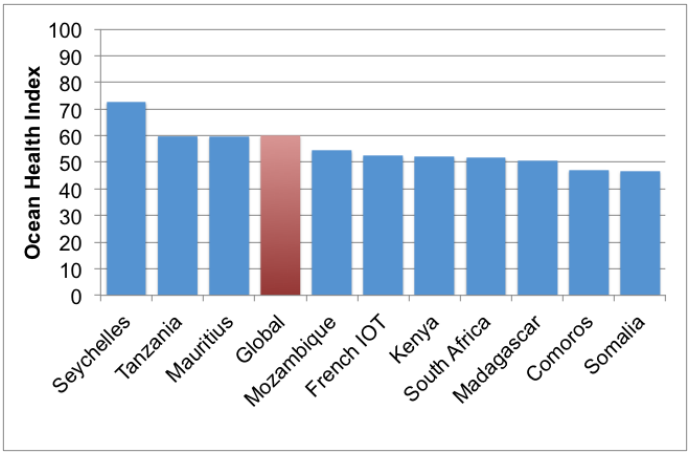


Fig. 3. OHI scores for countries of the Nairobi Convention/Western Indian Ocean region.Countries are ordered clockwise from highest to lowest from the top. See Table 1 for values.

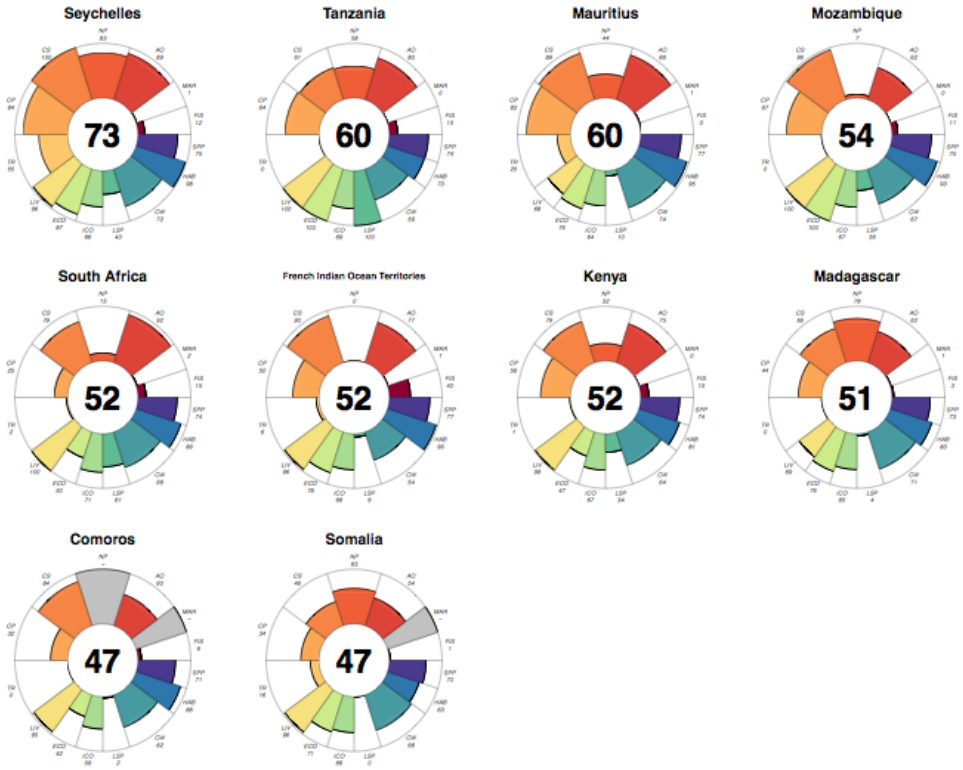


Fig. 4. OHI symbols for the countries of the Western Indian Ocean, showing the country score in the center, and the goal scores in the symbols radiating out around them. See fig. 1 for the labels on each goal and their colours.

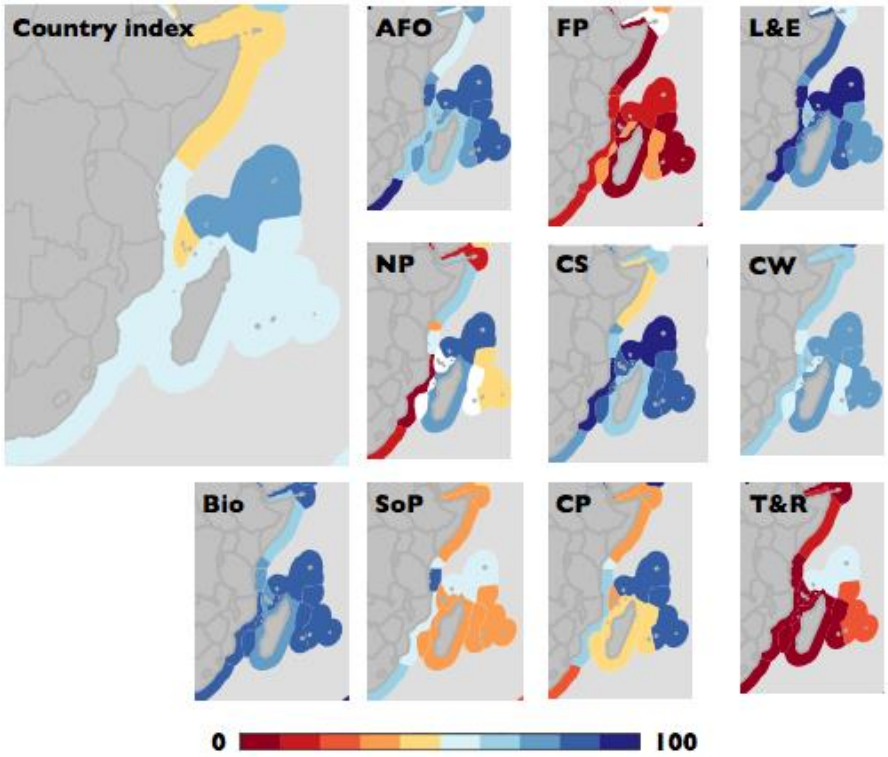


Fig. 5. WIO maps showing goal scores for each EEZ

- The OHI symbol is shown for each country in fig. 4, giving a holistic view of the overall and goal-specific performance of each country. This illustration highlights the country and the relative scoring of each goal within the country;
- Maps of the EEZs of each country (fig. 5) show the overall score and the score of each country for each goal. This illustration highlights overall performance of each goal in the region.
- The actual numbers used in these illustrations are shown in Table 1, including the sub-goal scores where appropriate (and see fig. 1)

Table 1. Goal and sub-goal scores for countries in the Nairobi Convention region.

		Goal/Sub-Goal Scores sorted by Index score																	
Country/EEZ	Index	FP			AO	NP	CS	CP	LE			TR	SP			CW	BD		
		FIS		MAR					LIV		ECO		ICO		LSP		HAB		SPP
Global (area-wt. avg.)	60	25	24	10	87	40	75	73	84	75	67	10	70	55	41	78	88	83	79
Seychelles	73	12	12	1	89	83	100	84	96	92	87	55	66	55	43	72	98	86	75
Tanzania	60	15	15	0	80	58	61	64	100	100	100	0	69	85	100	59	73	73	74
Mauritius	60	0	0	1	86	44	89	83	68	72	76	25	64	37	10	74	95	86	77
Mozambique	54	11	11	0	62	7	96	67	100	100	100	0	67	51	36	67	93	84	75
French Indian Ocean Terr.	52	40	37	1	77	0	90	50	96	87	78	6	66	36	6	54	96	87	77
Kenya	52	15	15	0	75	32	79	56	98	72	47	1	67	50	34	64	81	77	74
South Africa	52	15	15	2	92	15	79	25	100	75	50	2	71	66	61	68	89	81	74
Madagascar	51	3	2	1	60	78	66	44	69	72	76	0	65	35	4	71	83	78	73
Comoros	47	6	6		60		84	32	95	68	42	0	59	31	2	62	88	79	71
Somalia	47	1	1		54	65	46	34	96	83	71	16	66	33	0	68	63	66	70

Discussion within the WIO on the OHI results is likely to mirror feedback that has been obtained from the global release, such as the following points:

- R
  eference points – for example, for the wild capture fisheries subgoal, some have suggested it should be MSY rather than multispecies MSY minus 25 percent (the latter is more precautionary).
- G
  lobal data for fisheries catch and aquaculture production is poor quality.
- L
  imitations in terms of available global data for Tourism & Recreation produce strange scores for this goal for many countries.
- F
  or species, different comments for and against use of the IUCN Red List data has been received.

In considering these initial results of the global OHI output, it is important to note that values may not match the expectations or knowledge of governments or experts in the region. This may be due to a number of reasons, some of which are summarized below. The purpose of this document is to raise these as issues to be discussed in the region, in order to determine if the OHI, through a regionally-focused project under the Nairobi Convention, can be tailored to use in the region, and use regional datasets that may be more appropriate than the global ones presented here.
In the Annexes to this document, the range of goal scores in the region are presented, to illustrate how the OHI relates to conditions in the countries.

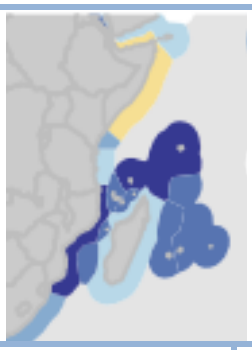
Concluding remarks

The paper and discussions of the results will be used to gauge interest to conduct a regionally focused application of the Ocean Health Index for the Nairobi Convention region in 2013-14. Contracting parties will be requested to note the Index as an important scientific tool to assess health of the region's oceans, and to endorse a partnership with Conservation International and other relevant partners in exploring its use in the region. Such an effort will culminate inan assessment of the usefulness of the Index for the countries of the Nairobi Convention region to assess the health of their EEZs, inform future management and policies, and to increase the provision of ocean benefits sustainably to the citizens and coastal communities of the countries.
In order to facilitate application of OHI at these levels, a software tool and manual are being developed that will allow users to calculate the OHI score at a finer level using higher resolution data and/or locally adapted models for calculating the goal scores. These are expected to be finalized by July 2013.

ANNEXES

The annexes to this document are presented to support discussion on the Ocean Health Index, and aspects of its application to the Nairobi Convention/Western Indian Ocean region.
Concurrently with this submission of a technical paper for the COP7 of the Nairobi Convention, these and additional data pages have been circulated to experts in the countries of the WIO for comment and feedback. This feedback will be collated and presented during the Science-Policy Workshop of the COP7, for final consideration of the technical/policy experts of the Nairobi Convention. Subsequently, the experts may present a summary of findings to the Parties of the Convention.

The annexes follow a consistent format for each of the goals and sub-goals being presented:

<table>
<tr><td>TITLE AND REGIONAL SCORE
Benefit: provided to societies
Objective: primary objective that the goal quantifies.</td><td>  </td><td>Illustration of the goal (and sub-goals, if relevant) score for each of the ten countries using the EEZ maps – see fig. 4 for colour codes.</td></tr>
<tr><td colspan="2">Reference points:
Explanation of how the reference point was determined for the global index.</td><td>Global results:
Summary of the global results.</td></tr>
<tr><td colspan="3">Western Indian Ocean results:
Summary of results for the Western Indian Ocean, for goal and each sub-goal. Interesting observations are noted.</td></tr>
<tr><td colspan="3">Points for regional discussion/regionalization in 2013-14:
In this section, points for discussion about calculation of the scores, their interpretation, and reference points are noted to stimulate feedback and discussion from readers. The emphasis for feedback is on relevant considerations for the WIO region, and that could be taken forward in a regional analysis in 2013-14.

To provide feedback on the scores, contact dobura@cordioea.net, with cc. to t.lee@conservation.org</td></tr>
</table>

The goals presented here have been selected for their prime importance to coastal economies in the region (Food Provision, Artisanal Fishing Opportunity, Livelihoods & Economies, Tourism and Recreation, Biodiversity), as well as for their potential relevance in coming years (Carbon Storage). Further, they are spread across the whole range of scores from very high (83, 87) to very low (10, 24), providing an opportunity to discuss the regional relevance of reference points. Please refer to Table 1 for a complete list of scores for the 11 Nairobi Convention countries.